Discovery and Exclusion Potential of Future Colliders for Supersymmetry Signatures

Electroweakinos with compressed mass spectra

Electroweakinos with fully hadronic final states

R-parity Violating signatures with 2 or 3 leptons

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Letter of Intent to EF0, EF8, RF4

October 2 2020

RF04 Townhall

SUSY: Cosmo & Pheno hinges on R-parity $= (-1)^{3(B-L)+2s}$

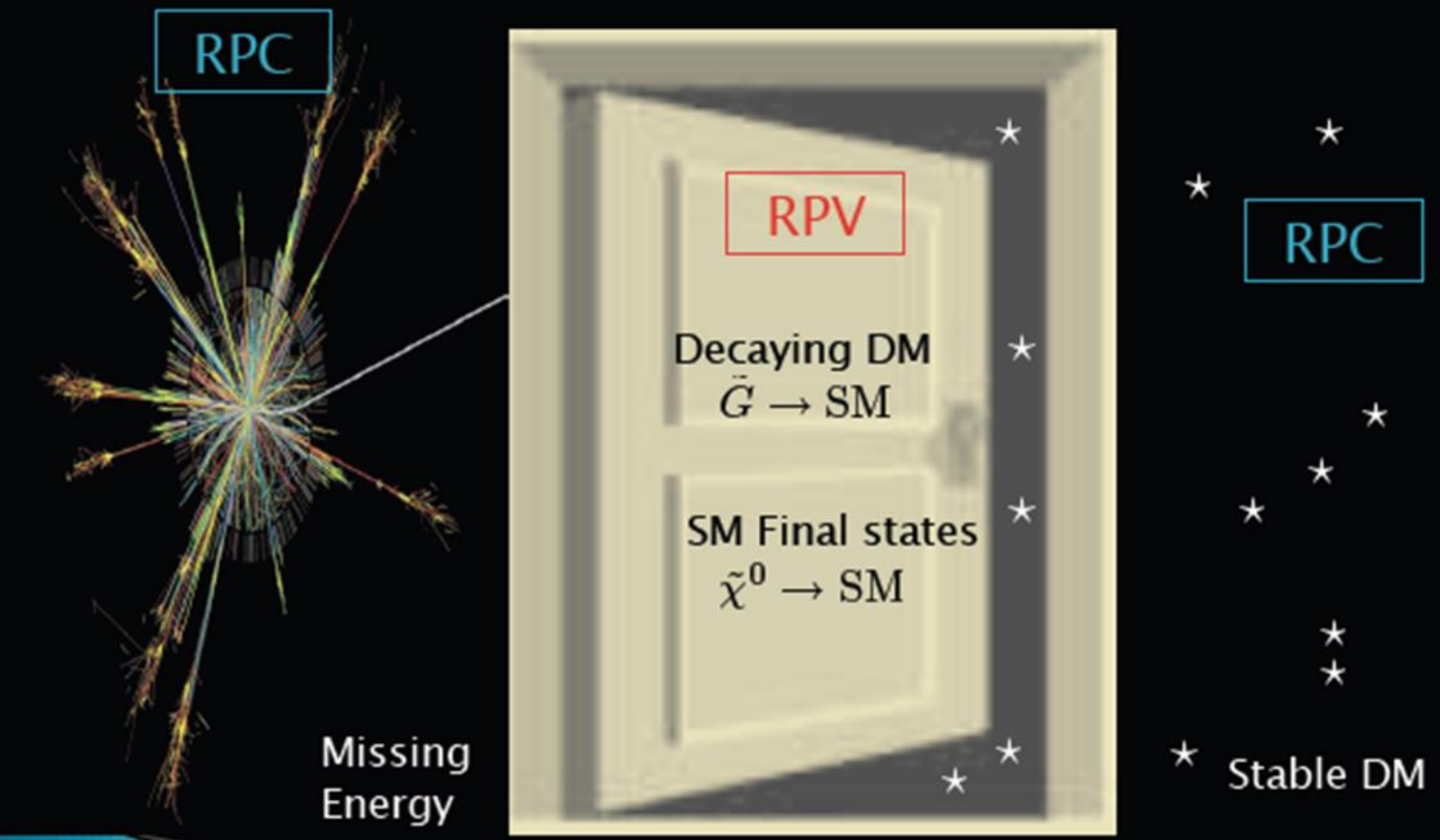


Figure from S. Spinner

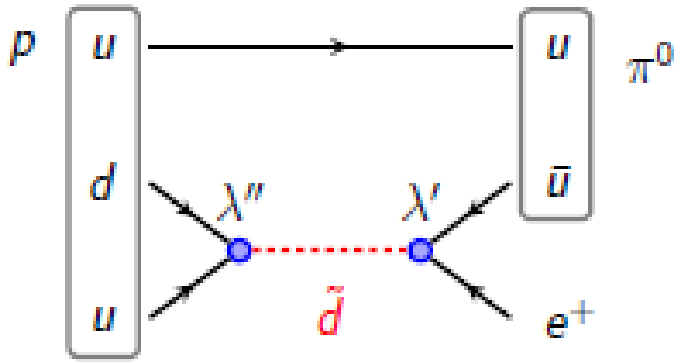
Question assumptions: do you prevent proton decay with

- a new quantum number called R-Parity?

  RPC & LSP stable as DM

- a new U(1) gauge symmetry with B-L charge?

  RPV & LSP decays to SM



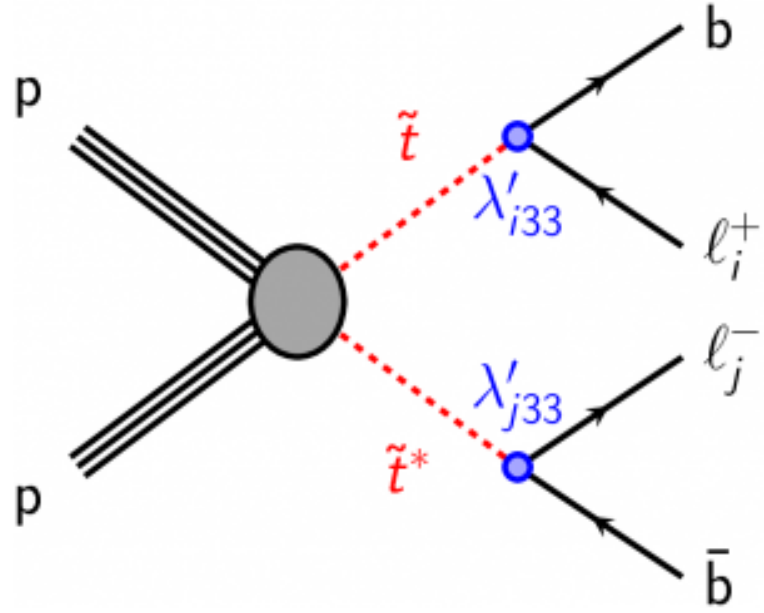
Physics Motivation

Motivation: RPV searches for supersymmetry of active interest at LHC, but under-represented in studies at future colliders

Goal: **compare discovery and exclusion potential for two searches** performed by our group on ATLAS at **future hadron and lepton colliders**

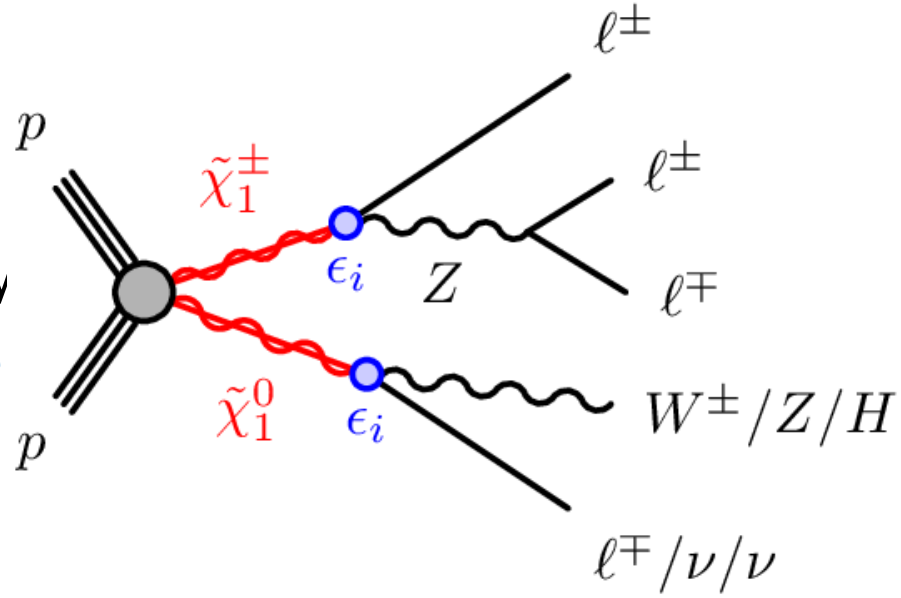
- More data at HL-LHC
- Higher center-of-mass energy at HE-LHC and FCC-hh
- Cleaner environment at lepton colliders ILC, CLIC, LE-FCC

Model: MSSM with RH neutrinos and U(1) B-L charge, broken by RH sneutrino. Significant difference is LSP can decay via tiny RPV couplings related to neutrino masses,



(1) Scalar top LSP with RPV decay giving a lepton-b-jet resonance

- Requirements: lepton identification, jets, b-tagging
- Dominant backgrounds: **ttbar**, **single top (Wt)**, **Z+jets** needed at high total transverse energy



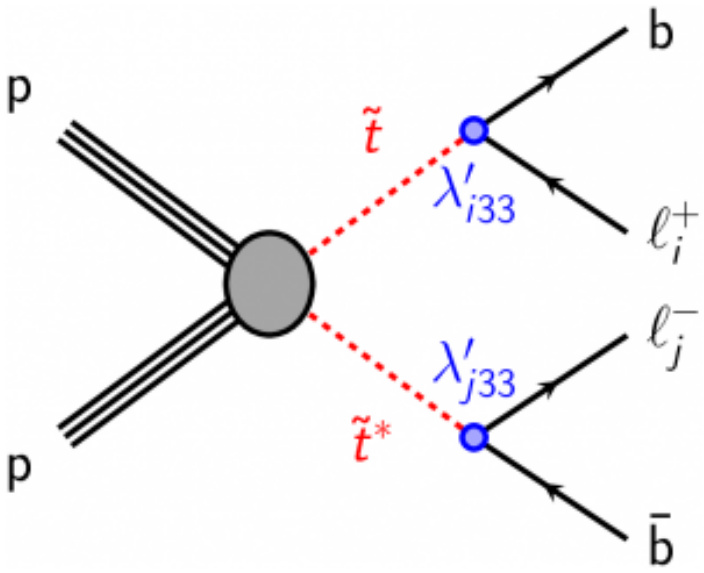
(2) Electroweakino LSP with RPV decay giving a trilepton resonance

- Requirements: lepton identification
- Dominant backgrounds **WZ**, **ZZ**, **ttZ**

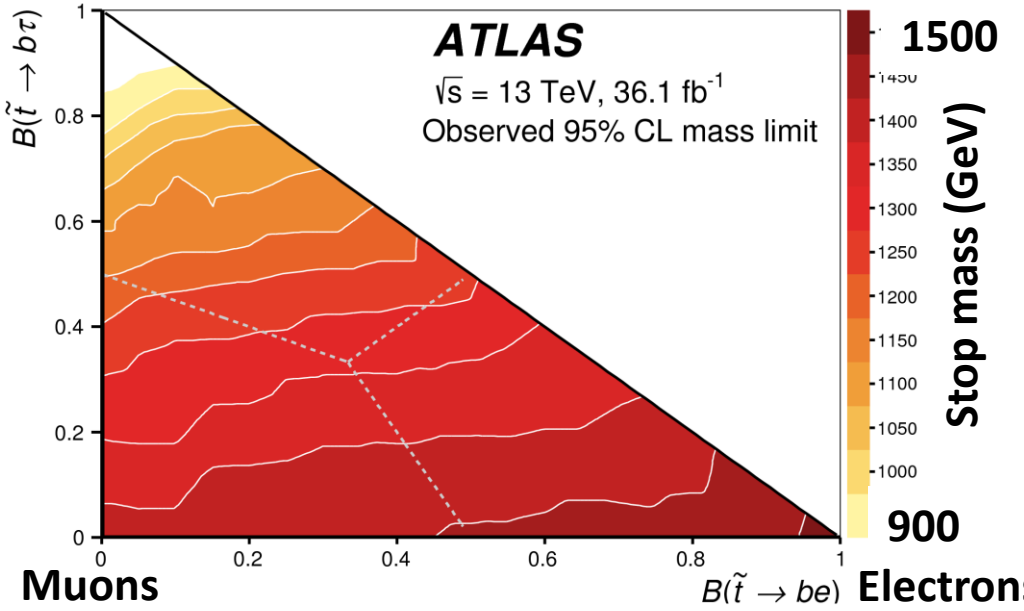
RPV Stop search

ATLAS 36/fb PRD 97 (2018) 032003

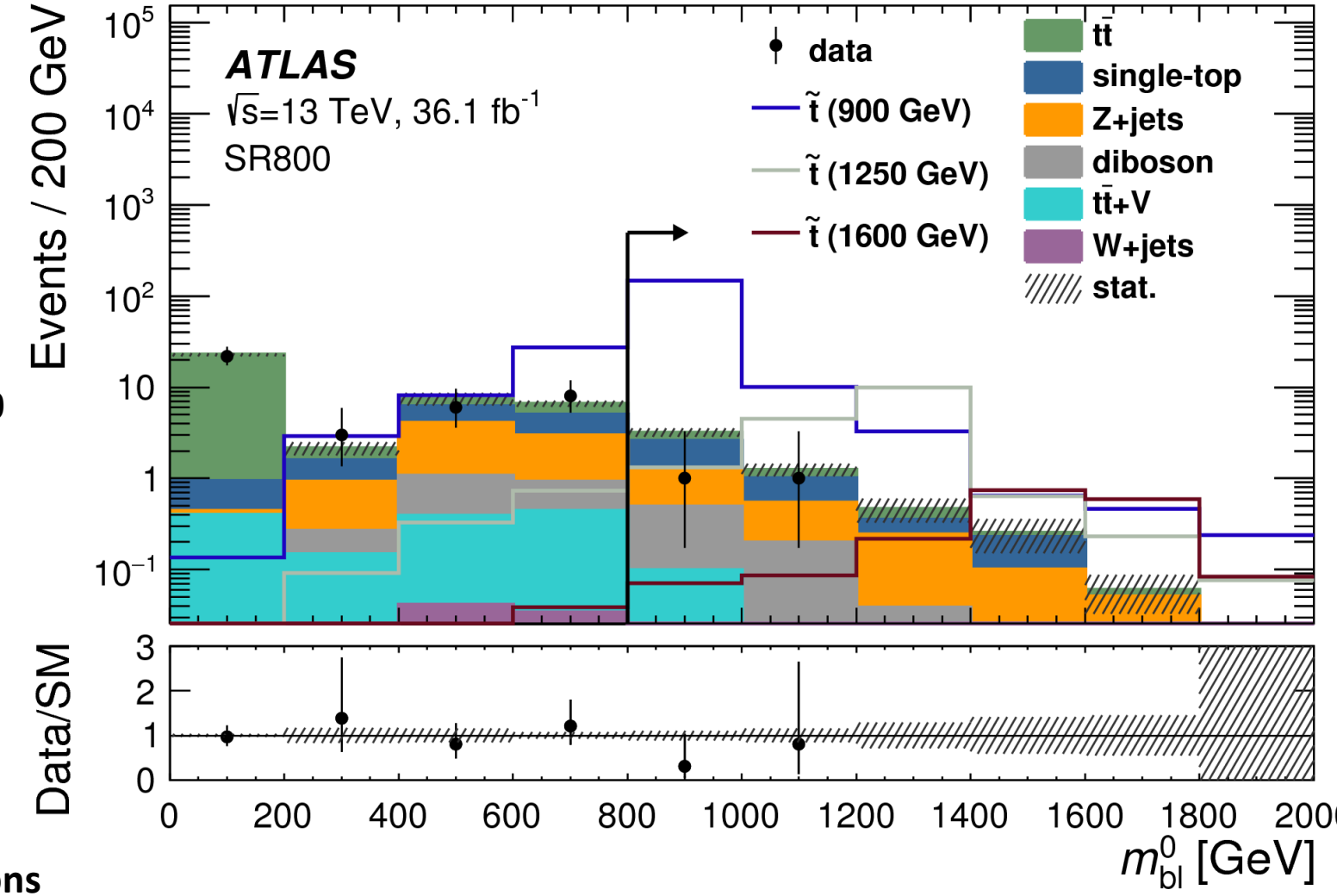
Two lepton-b-jet resonances directly reconstruct stop mass
Limits depend on stop BR to each lepton flavor



Taus



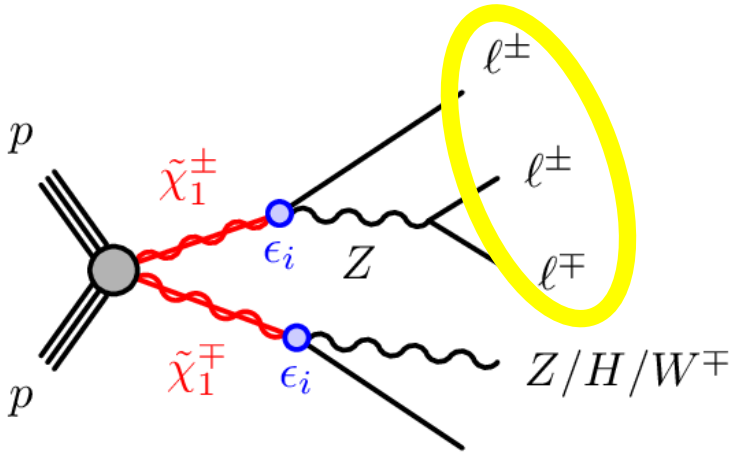
Muons **Electrons**

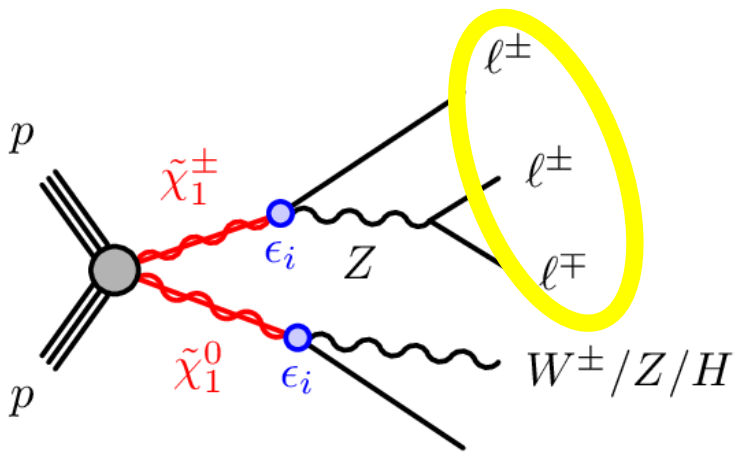


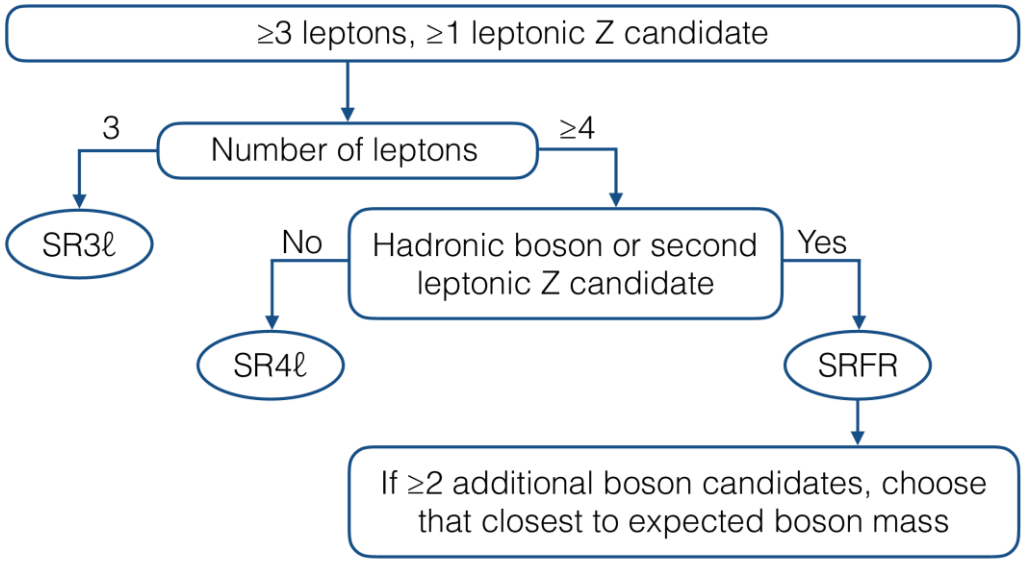
RPV Electroweakino search

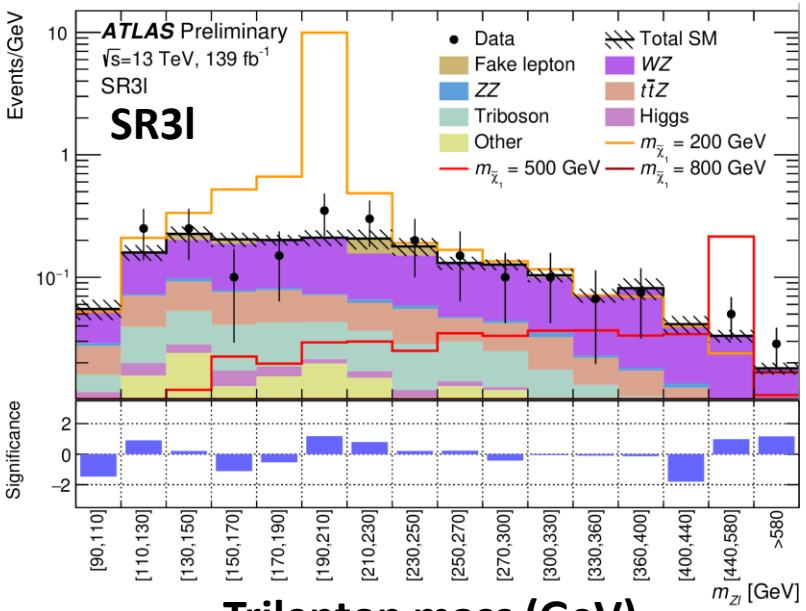
ATLAS 139/fb ATLAS-CONF-2020-009

Trilepton mass directly reconstructs chargino mass

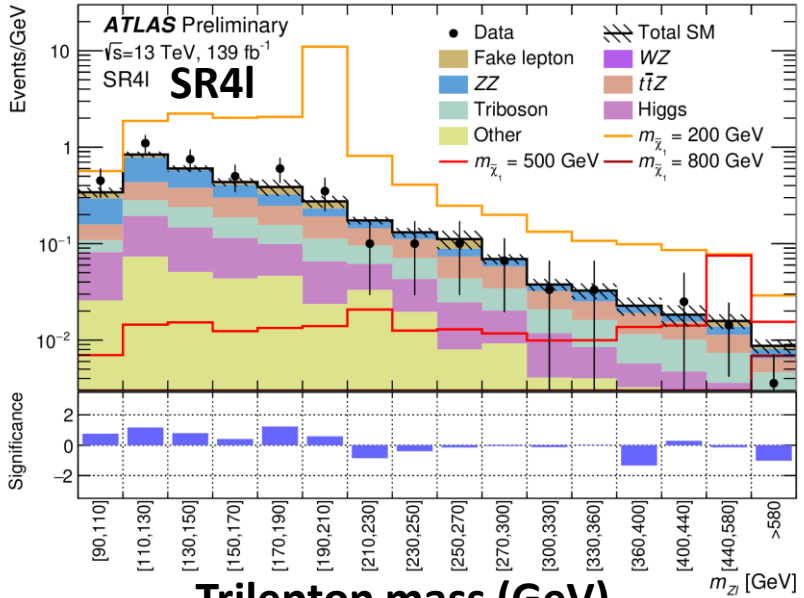








Trilepton mass (GeV)



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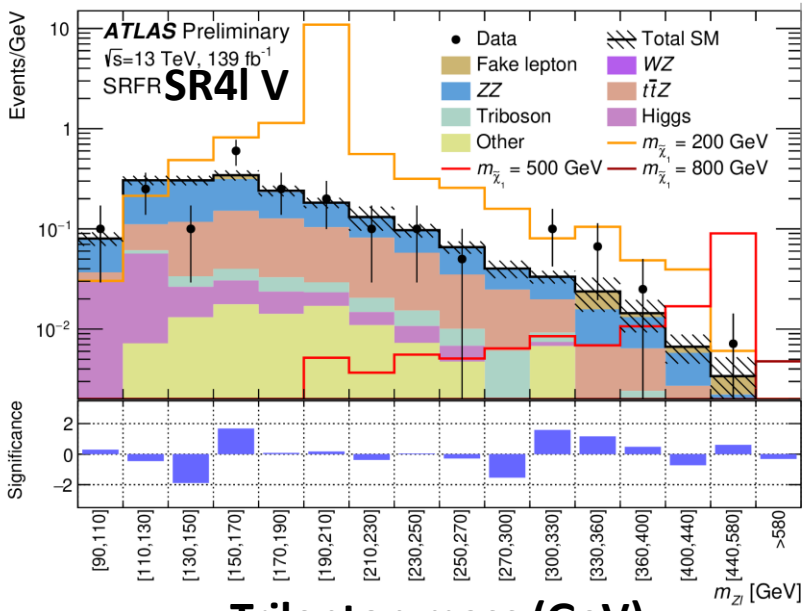

Trilepton mass (GeV)

RPV Electroweakino search

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Limits depend on BR for chargino decay to Z and lepton (y-axis), and lepton flavor (inclusive)